IN THE CLAIMS:

Please add claims 32-38.

1. (Original) A method for measuring dry density and gravimetric water content of soil, comprising the steps of:

providing a plurality of spikes adapted to be driven into the soil;

driving said plurality of spikes into the soil in spaced relationship;

applying to said plurality of spikes an electrical signal suitable for time domain reflectometry;

analyzing a reflected signal using time domain reflectometry to determine an apparent dielectric constant K_a of the soil and bulk electrical conductivity EC_b of the soil;

calculating dry density ρ_d of the soil using a predetermined relationship between K_a, EC_b and ρ_d; and

calculating gravimetric water content w of the soil using a predetermined relationship between K_a, EC_b, and w.

2. (Original) The method of claim 1, wherein the soil has a surface and the plurality of spikes have a lower end, and the step of analyzing a reflected signal includes measuring the apparent distance between a signal reflected from the surface of the soil and a signal reflected from the lower end of said plurality of spikes to determine an apparent length La.

3. (Original) The method of claim 2, wherein said plurality of spikes have a probe length Lp and the apparent dielectric constant $K_a = (La/Lp)^2$.

4. (Original) The method of claim 1, wherein the step of analyzing a reflected signal includes measuring a source voltage Vs of the applied signal and a long term voltage Vf of the reflected signal.

5. (Original) The method of claim 4, wherein the bulk electrical conductivity $EC_b = (1/C)(Vs/Vf - 1)$ where C is a constant related to probe length Lp.

6. (Original) The method of claim 1, wherein the predetermined relationship between K_a, EC_b and ρ_d is $\rho_d = \frac{d\sqrt{K_a} - b\sqrt{EC_b}}{ad - cb}$, where *a, b, c* and *d* are soil specific calibration constants.

7. (Original) The method of claim 6, wherein calibration constants *a* and *b* are predetermined experimentally for a given soil using the relationship $\sqrt{K_a}\frac{\rho_w}{\rho_d} = a + bw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and *w* is the gravimetric water content of the soil.

8. (Original) The method of claim 7, wherein EC_b is replaced with an adjusted value $EC_{b,\ adj}$ for which calibration constants c and d are known.

9. (Original) The method of claim 1, wherein the predetermined relationship between K_a, EC_b and *w* is $w = \frac{c\sqrt{K_a} - a\sqrt{EC_b}}{b\sqrt{EC_b} - d\sqrt{K_a}}$, where *a, b, c* and *d* are soil specific calibration constants.

10. (Original) The method of claim 9, wherein calibration constants *c* and *d* are predetermined experimentally for a given soil using the relationship $\sqrt{EC_b}\frac{\rho_w}{\rho_d} = c + dw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and *w* is the gravimetric water content of the soil.

11. (Original) The method of claim 10, wherein EC_b is replaced with an adjusted value $EC_{b,\ adj}$ for which calibration constants c and d are known.

12. (Original) The method of claim 11, wherein the calculated value of K_a at a given temperature is adjusted to a value $K_{a,\ 20°C}$ at a standard temperature of 20°C, where

$$K_{a,20°C} = K_{a,T} \times TCF$$

and where TCF = Temperature Compensation Function

= 0.97 + 0.0015 $T_{test,°C}$ for cohesionless soils, 4°C $\leq T_{test,\ °C} \leq$ 40°C

= 1.10 - 0.005 $T_{test,°C}$ for cohesive soils, 4°C $\leq T_{test,\ °C} \leq$ 40°C.

13. (Original) A method for measuring dry density of soil, comprising the steps of:

providing a plurality of spikes adapted to be driven into the soil;

driving said plurality of spikes into the soil in spaced relationship;

applying to said plurality of spikes an electrical signal suitable for time domain reflectometry;

analyzing a reflected signal using time domain reflectometry to determine an apparent dielectric constant K_a of the soil and bulk electrical conductivity EC_b of the soil; and

calculating dry density ρ_d of the soil using a predetermined relationship between K_a, EC_b and ρ_d.

14. (Original) The method of claim 13, wherein the predetermined relationship between K_a, EC_b and ρ_d is $\rho_d = \frac{d\sqrt{K_a} - b\sqrt{EC_b}}{ad - cb}$, where *a, b, c* and *d* are soil specific calibration constants.

15. (Original) The method of claim 14, wherein calibration constants *a* and *b* are predetermined experimentally for a given soil using the relationship $\sqrt{K_a}\frac{\rho_w}{\rho_d} = a + bw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and *w* is the gravimetric water content of the soil.

16. (Original) The method of claim 14, wherein calibration constants *c* and *d* are predetermined experimentally for a given soil using the relationship $\sqrt{EC_b}\frac{\rho_w}{\rho_d} = c + dw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and *w* is the gravimetric water content of the soil.

17. (Original) The method of claim 14, wherein EC_b is replaced with an adjusted value $EC_{b,\,adj}$ for which calibration constants c and d are known.

18. (Original) The method of claim 17, wherein the calculated value of K_a at a given temperature is adjusted to a value $K_{a,\,20°C}$ at a standard temperature of 20°C, where

$$K_{a,20^{\circ}C} = K_{a,T} \times TCF$$

and where TCF = Temperature Compensation Function

$= 0.97 + 0.0015\ T_{test,°C}$ for cohesionless soils, $4°C \leq T_{test,\,°C} \leq 40°C$

$= 1.10 - 0.005\ T_{test,°C}$ for cohesive soils, $4°C \leq T_{test,\,°C} \leq 40°C$.

19. (Original) A method for measuring gravimetric water content of soil, comprising the steps of:

providing a plurality of spikes adapted to be driven into the soil;

driving said plurality of spikes into the soil in spaced relationship;

applying to said plurality of spikes an electrical signal suitable for time domain reflectometry;

analyzing a reflected signal using time domain reflectometry to determine an apparent dielectric constant K_a of the soil and bulk electrical conductivity EC_b of the soil; and

calculating gravimetric water content w of the soil using a predetermined relationship between K_a, EC_b, and w.

20. (Original) The method of claim 19, wherein the predetermined relationship between K_a, EC_b and w is $w = \dfrac{c\sqrt{K_a} - a\sqrt{EC_b}}{b\sqrt{EC_b} - d\sqrt{K_a}}$, where a, b, c and d are soil specific calibration constants.

21. (Original) The method of claim 20, wherein calibration constants a and b are predetermined experimentally for a given soil using the relationship $\sqrt{K_a}\dfrac{\rho_w}{\rho_d} = a + bw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and w is the gravimetric water content of the soil.

22. (Original) The method of claim 20, wherein calibration constants c and d are predetermined experimentally for a given soil using the relationship $\sqrt{EC_b}\dfrac{\rho_w}{\rho_d} = c + dw$, where ρ_w is the density of water, ρ_d is the dry density of the soil, and w is the gravimetric water content of the soil.

23. (Original) The method of claim 22, wherein EC_b is replaced with an adjusted value $EC_{b,\ adj}$ for which calibration constants c and d are known.

24. (Original) The method of claim 23, wherein the calculated value of K_a at a given temperature is adjusted to a value $K_{a,\ 20°C}$ at a standard temperature of 20°C, where

$$K_{a,20^\circ C} = K_{a,T} \times TCF$$

and where TCF = Temperature Compensation Function

$= 0.97 + 0.0015\ T_{test,°C}$ for cohesionless soils, $4°C \leq T_{test,\ °C} \leq 40°C$

$= 1.10 - 0.005\ T_{test,°C}$ for cohesive soils, $4°C \leq T_{test,\ °C} \leq 40°C$.

25. (Original) An apparatus for measuring dry density of soil, comprising:

a plurality of spikes adapted to be driven into the soil in spaced relationship;

means for applying to said plurality of spikes an electrical signal suitable for time domain reflectometry;

means for analyzing a reflected signal using time domain reflectometry to determine an apparent dielectric constant K_a of the soil and bulk electrical conductivity EC_b of the soil; and

means for calculating dry density ρ_d of the soil using a predetermined relationship between K_a, EC_b and ρ_d.

26. (Original) The apparatus of claim 25, wherein the predetermined relationship between K_a, EC_b and ρ_d is $\rho_d = \dfrac{d\sqrt{K_a} - b\sqrt{EC_b}}{ad - cb}$, where *a, b, c* and *d* are soil specific calibration constants.

27. (Original) The apparatus of claim 26, further comprising means for calculating gravimetric water content *w* of the soil using a predetermined relationship between K_a, EC_b, and *w*.

28. (Original) The apparatus of claim 25, further comprising means for compensating for soil temperature.

29. (Original) An apparatus for measuring gravimetric water content of soil, comprising:

a plurality of spikes adapted to be driven into the soil in spaced relationship;

means for applying to said plurality of spikes an electrical signal suitable for time domain reflectometry;

means for analyzing a reflected signal using time domain reflectometry to determine an apparent dielectric constant K_a of the soil and bulk electrical conductivity EC_b of the soil; and

means for calculating gravimetric water content w of the soil using a predetermined relationship between K_a, EC_b, and w.

30. (Original) The apparatus of claim 29, wherein the predetermined relationship between K_a, EC_b and w is $w = \frac{c\sqrt{K_a} - a\sqrt{EC_b}}{b\sqrt{EC_b} - d\sqrt{K_a}}$, where a, b, c and d are soil specific calibration constants.

31. (Original) The apparatus of claim 29, further comprising means for compensating for soil temperature.

32. (New) The method of claim 13, wherein said predetermined relationship includes a difference between a function of K_a and a function of EC_b.

33. (New) The method of claim 32, wherein EC_b is adjusted to reflect a predetermined soil pore fluid electrical conductivity.

34. (New) The method of claim 13, wherein EC_b is adjusted to reflect a predetermined soil pore fluid electrical conductivity.

35. (New) The method of claim 19, wherein said predetermined relationship includes a difference between a function of K_a and a function of EC_b.

36. (New) The method of claim 35, wherein said predetermined relationship includes a ratio of said difference and a second difference between a function of K_a and a function of EC_b.

37. (New) The method of claim 36, wherein EC_b is adjusted to reflect a predetermined soil pore fluid electrical conductivity.

38. (New) The method of claim 19, EC_b is adjusted to reflect a predetermined soil pore fluid electrical conductivity.